EV Charging and Grid Integration Tool

Workshop for E-mobility Support and Investment Platform for Central and Eastern Europe, West Asia & Middle East,
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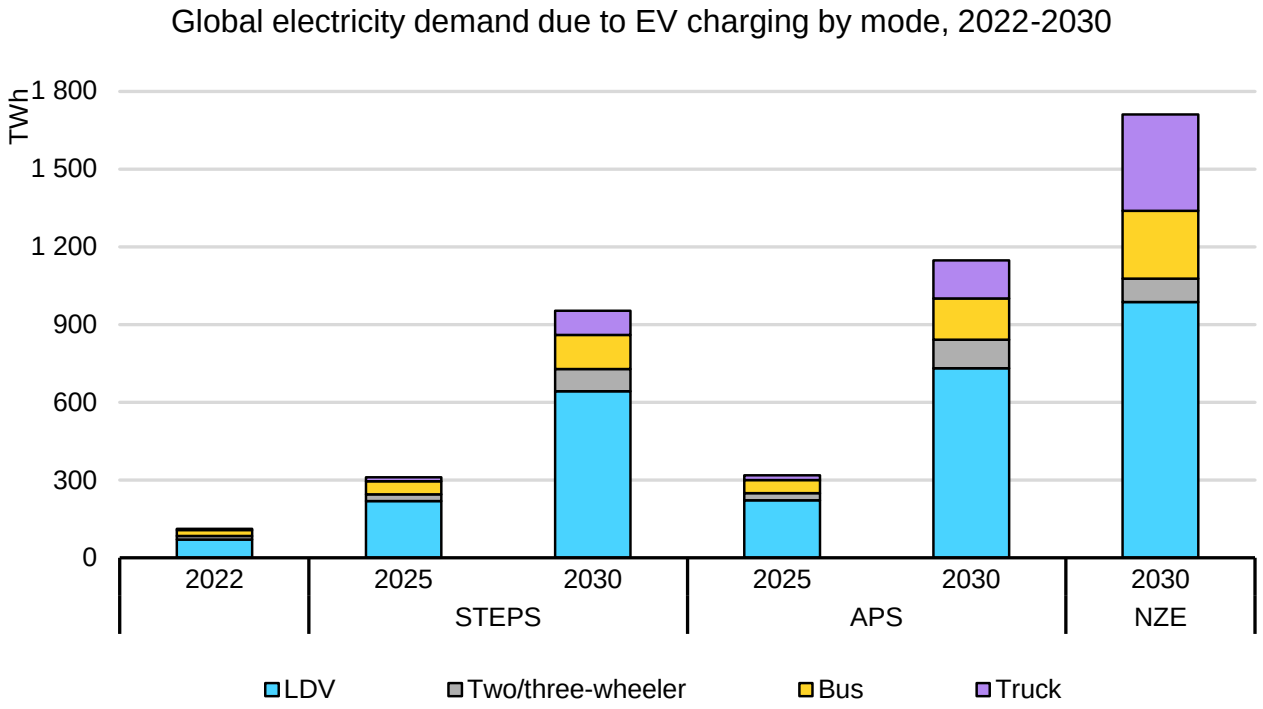
International Energy Agency

Outline

- Grid integration of EVs
- EV Charging and Grid Integration Tool
- Q&A

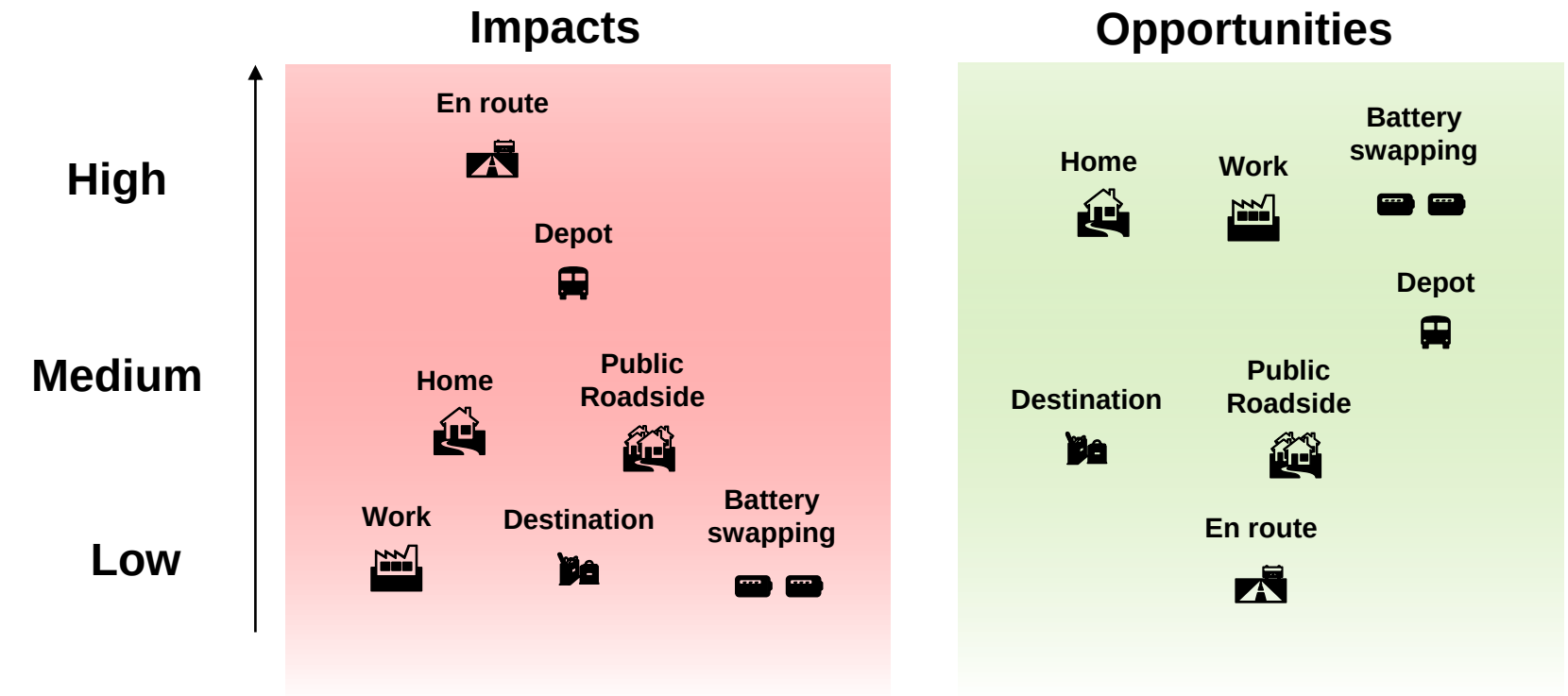
EV charging demand and faster charging will grow substantially



Source: IEA (2023), Global Electric Vehicle Outlook 2023

Global EV charging demand will grow from 110 TWh today to 950-1700 TWh in 2030.
Larger vehicle sizes (which require faster charging) could account for over a third of global EV charging demand.

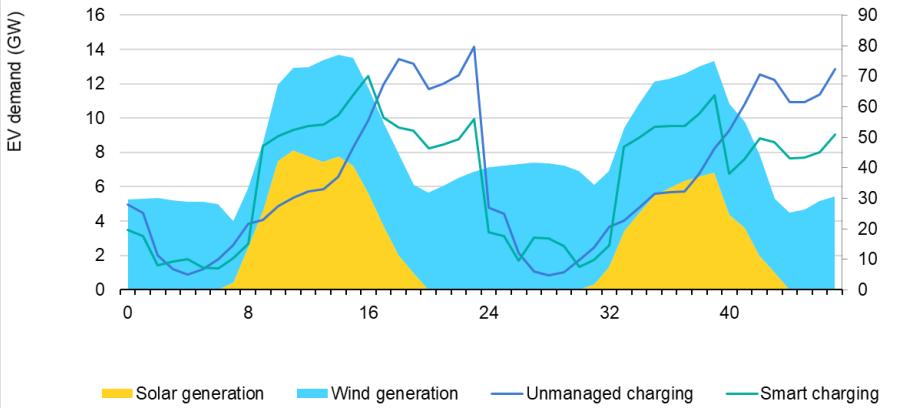
Road transport electrification: from challenges to opportunities



Managed (flexible) charging unlocks demand flexibility, reduces peak demand and grid congestion, and accelerates electricity decarbonisation.

Charging flexibility is needed to lower system costs and emissions

Electric vehicle load profiles for unmanaged and smart charging relative to solar and wind availability in Korea 2035 APS



System cost savings for the EV fleet when charging is optimised

	Peak costs	Operating costs	Emissions
$/MWh avoided	18	21	/
% Reduction	30%	21%	21%

Source: IEA (2021), Reforming Korea's Electricity Market for Net Zero

Smart charging enables larger contributions of EVs in reducing emissions, operational costs and peak capacity needs for the system.

Effective and coordinated action is needed to integrate EVs successfully at scale

4 key steps for policy makers to successfully integrate EVs

① Prepare institutions for the electric mobility transition

1. Engage electric mobility stakeholders
2. Break silos in planning and policy making

② Assess the power system impacts

1. Define an electric mobility strategy
2. Gather data and develop insights
3. Assess the grid impacts under mobility scenarios

③ Deploy measures for grid integration

1. Accommodate all charging solutions but encourage managed charging
2. Facilitate aggregation by enforcing standards and interoperability
3. Value the flexibility of EVs
4. Co-ordinate EV charging with renewables
5. Incentivise smart-readiness

④ Improve planning practices

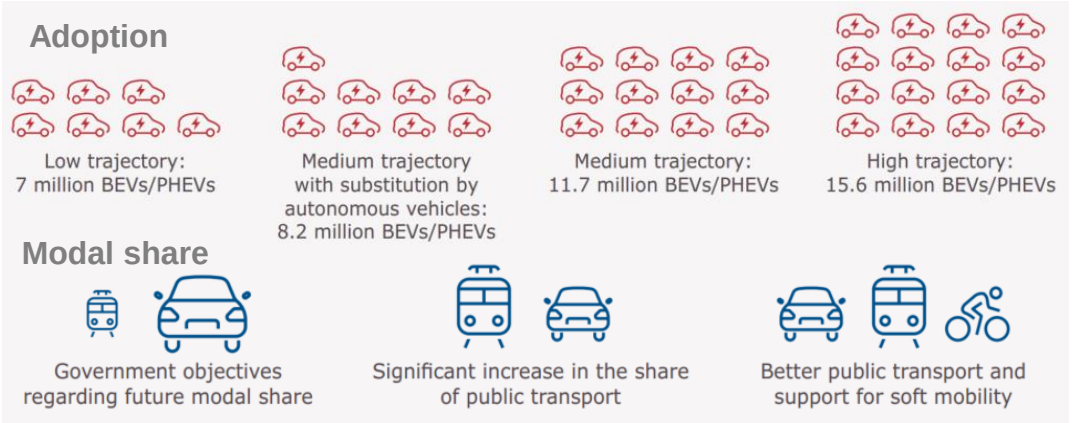
1. Conduct proactive grid planning
2. Reflect the full value of EV charging

② Assess the power system impacts

Recommendations for assessing the power system impacts

Develop mobility scenarios

- By transmission system operator (France)
- By national laboratory (United States)



Source: RTE (2019) Integration of electric vehicles into the power system of France

Develop travel surveys

- Travel surveys (Chile, Thailand)
- EV charging patterns (France)

Deploy digital Technologies

- GPS in LDVs and in Trucks (United States, Europe)

Record charging sessions + open access

- Obligation in public tender (Germany)

③ Deploy measures for grid integration

A framework for grid integration of electric vehicles

PHASE 1: No noticeable impact	**PHASE 2:** EV load noticeable with low flexibility demand	**PHASE 3:** Flexible EV load is significant with high flexibility demand	**PHASE 4:** Flexible EV load is highly available with high flexibility demand
No significant impact yet. Encourage higher EV uptake through incentives and public EVSE deployment.	Distinct variability observed caused by EV charging but demand for flexibility is low enough that simple flexibility measures would suffice.	Demand for flexibility is high, matching the availability of flexible EV load and paving the way for aggregated smart charging.	High flexibility demand along with highly available flexible EV load can provide energy back to the system in periods of deficit.
Co-ordinate charging station deployment in areas beneficial to the grid	**Passive measures:** time-of-use tariffs, vehicle-based charging time delays	Deploy active measures: unidirectional V1G	Deploy active measures, bidirectional charging: V2G
Most countries today	**Norway**	**France, Netherlands, United States**	**Island power systems, certain vehicle segments**

Source: IEA (2022), Grid Integration of Electric Vehicles

Interactive web tool:
EV Charging and Grid Integration tool
http://www.iea.org/data-and-statistics/data-tools/ev-charging-and-grid-integration-tool

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EV Charging and Grid Integration Tool

EV Charging and grid integration tool

Motivation #1

Assessing the impact of EV charging on the power system

Module 1

Simulation of EV charging behaviour

Output: weekly EV charging demand profile

Motivation #2

Assessing effect of measures for mitigating EV charging impacts

Module 2

Simulation of EV charging behaviour with managed charging

Output: weekly EV charging demand profile with managed charging

Motivation #3

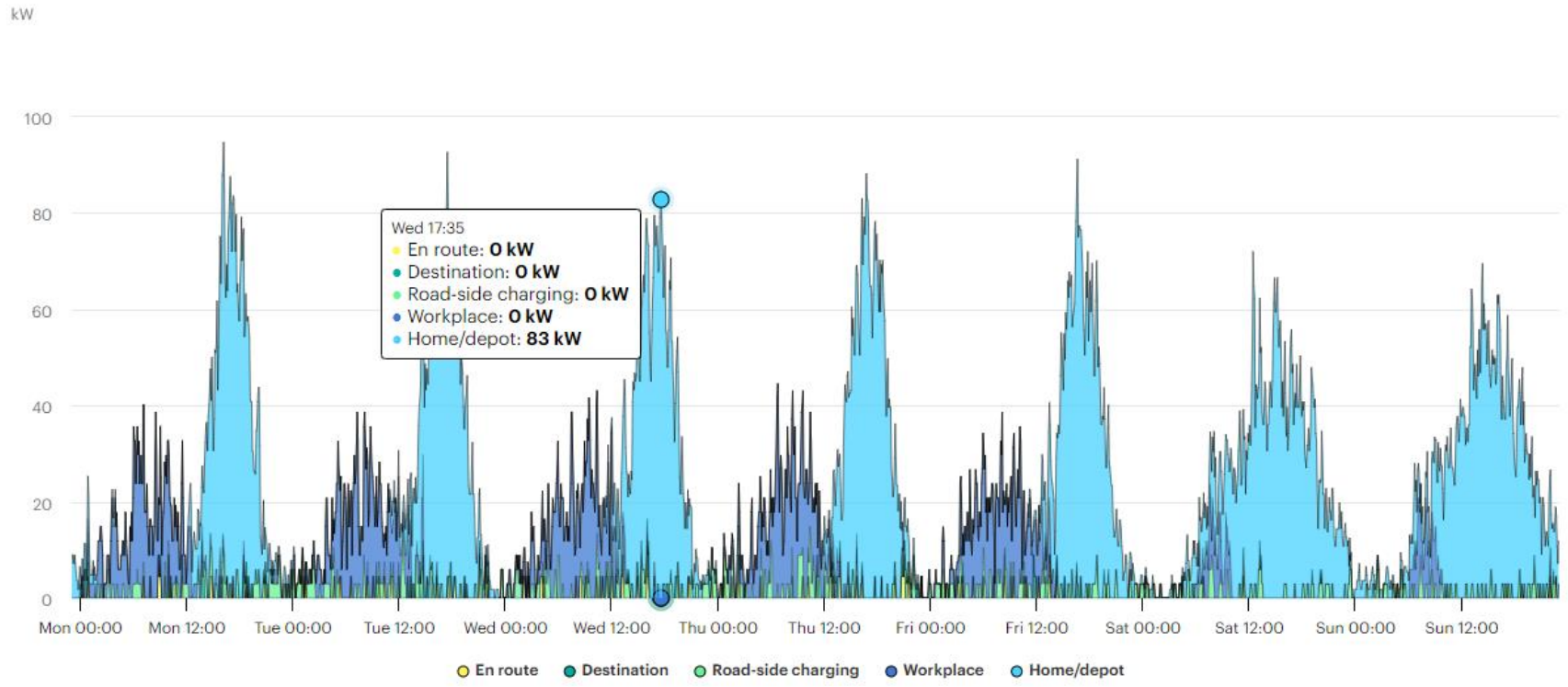
Estimating the CO_2 emissions related to EV charging

Module 3

Simplified representation of the electricity mix

Output: calculation of yearly CO_2 emissions

IEA's EV Charging and Grid Integration Tool

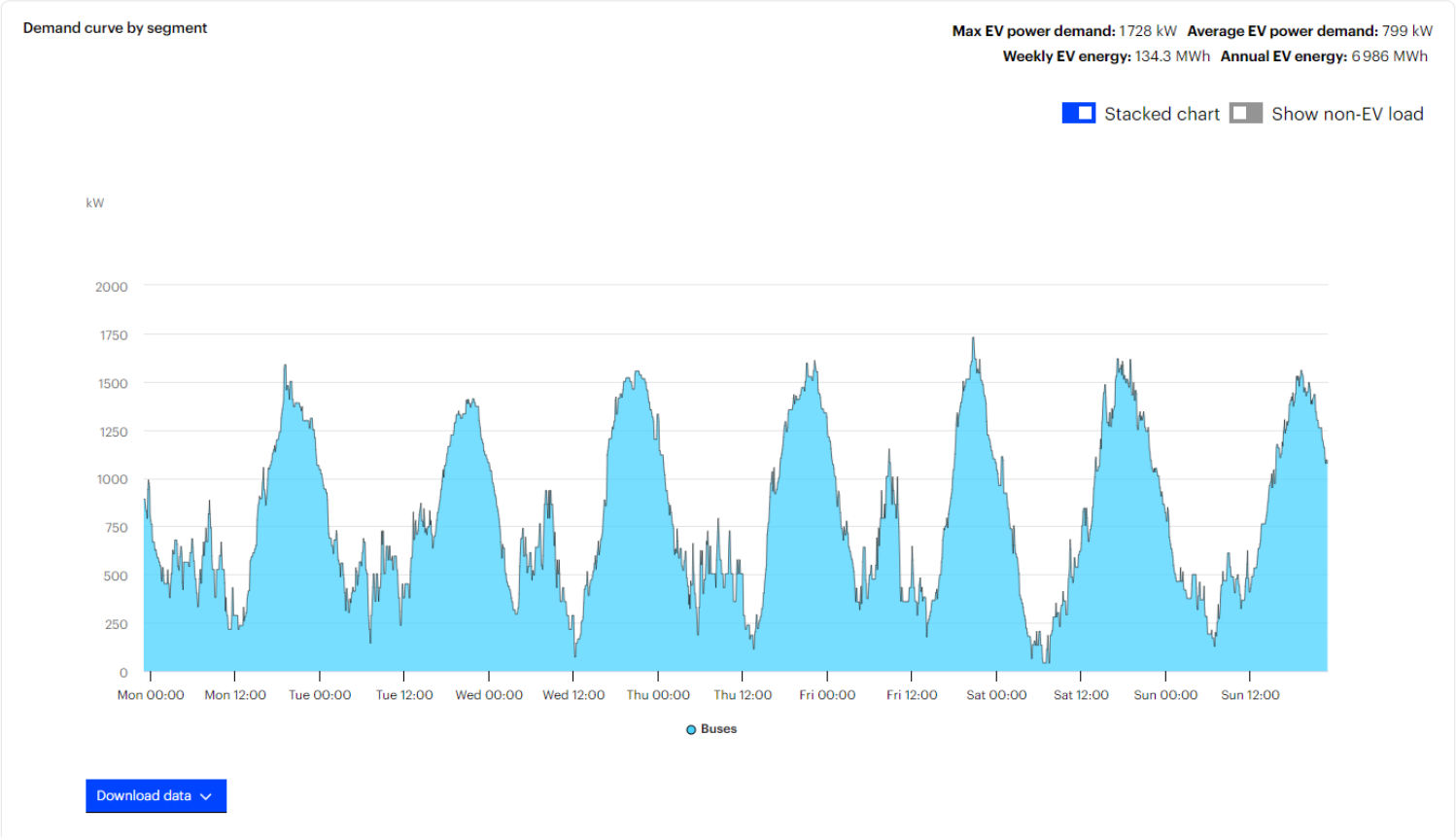


The tool's main output is a weekly EV charging demand profile, enabling understanding of the impacts of charging schemes, driving behaviour and infrastructure availability on power demand and emissions.

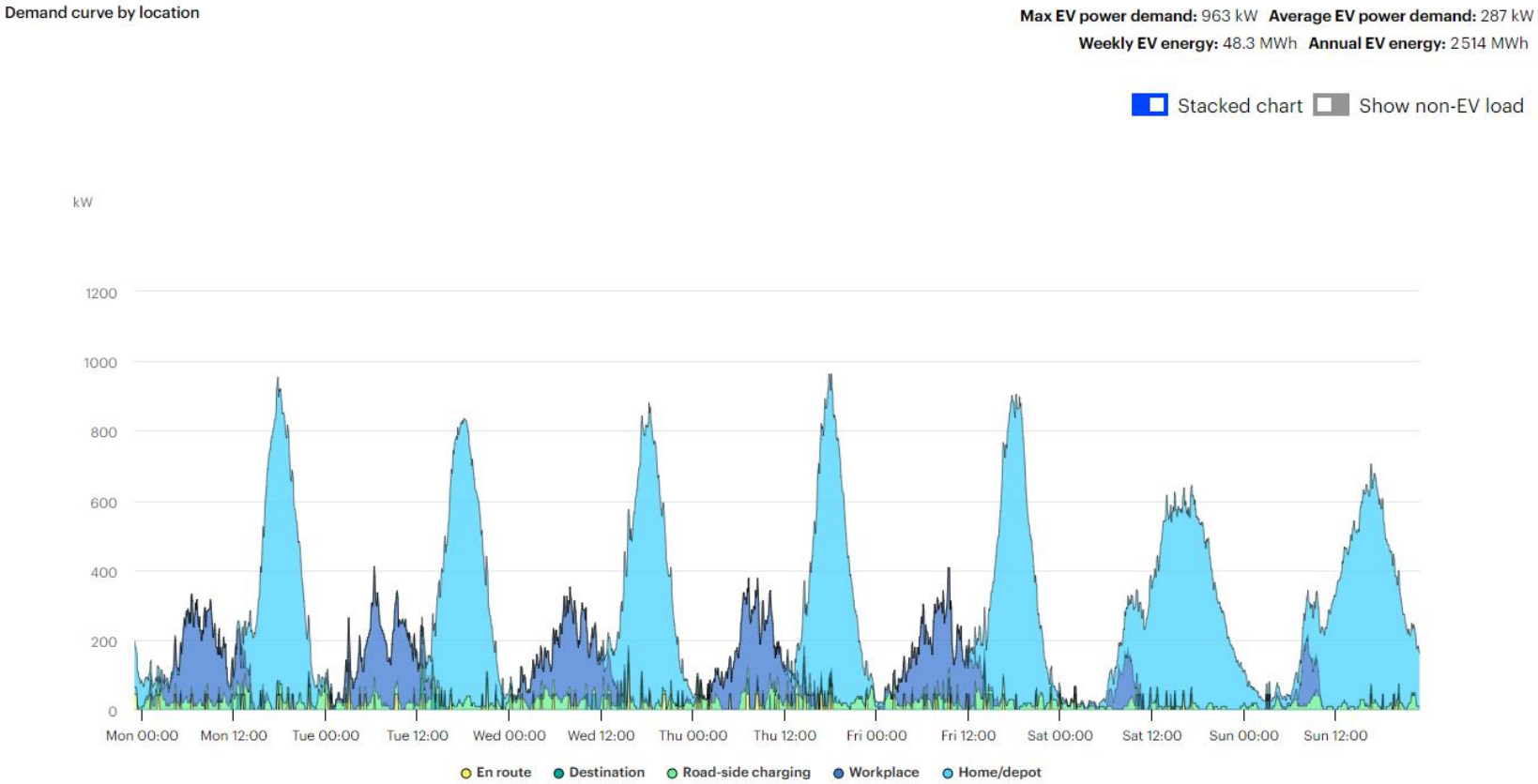
Motivation #1 (Module 1)

Assessing the impact of EV charging on the power system

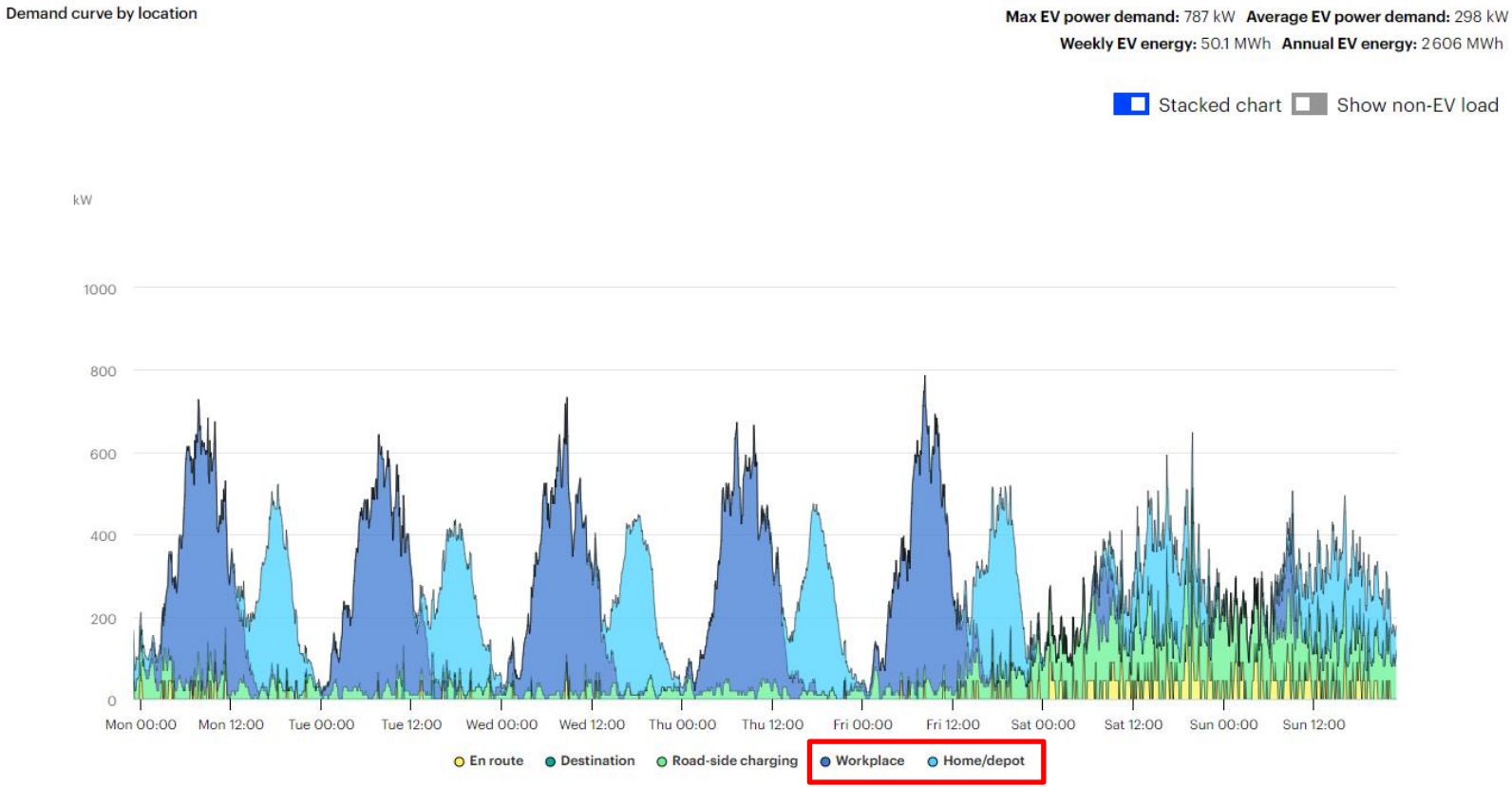
Ex: 100 buses – base example



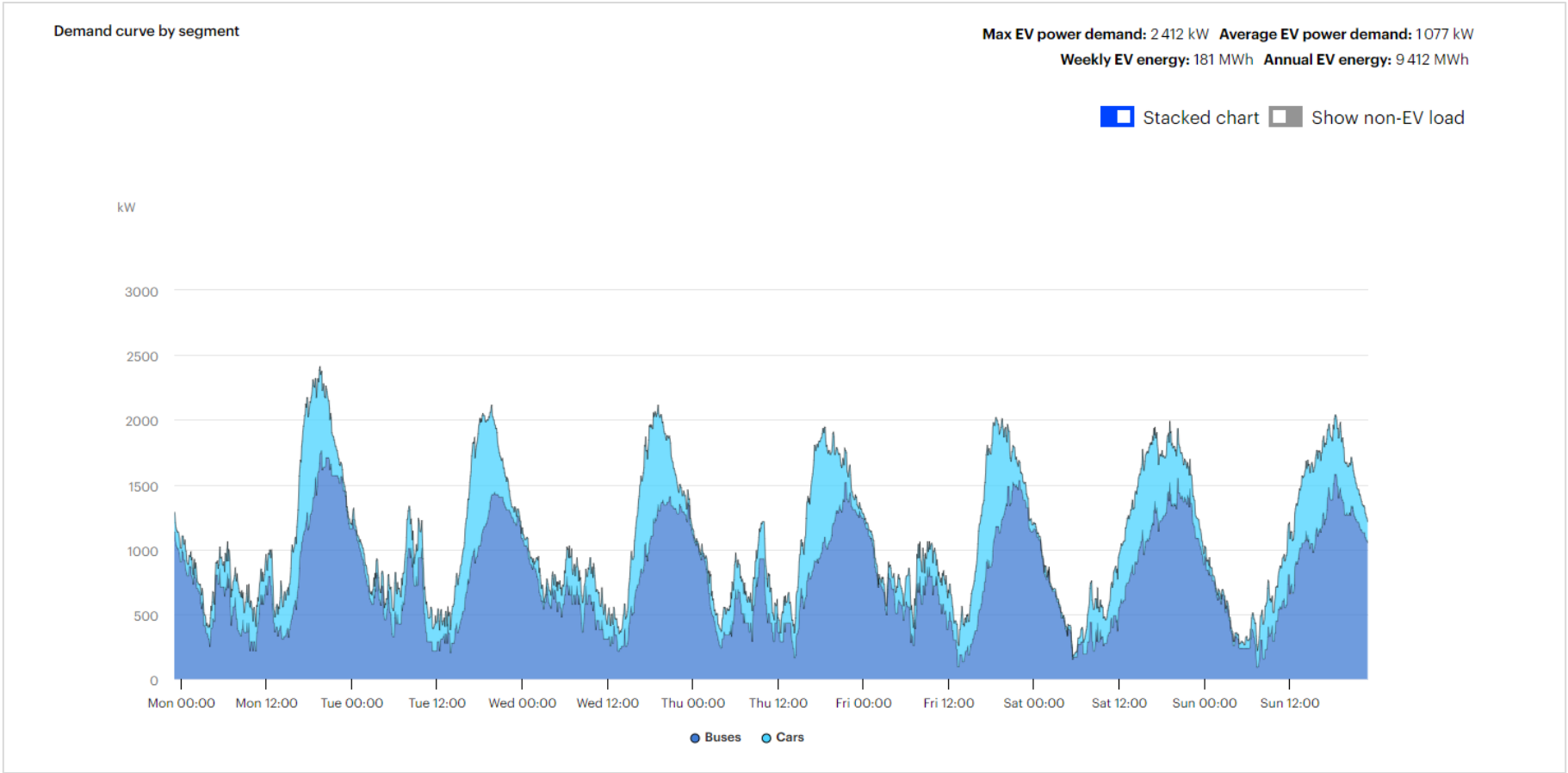
Ex: 1000 cars



Ex: 1000 cars – lower access to home/depot charging



Ex: 1000 cars overlapped with 100 buses



Motivation #2 (Module 2)

Implementing managed (more flexible) charging

Applying managed charging measures

Is managed charging possible?

Checking flexibility

Energy required to charge EV

Flexibility

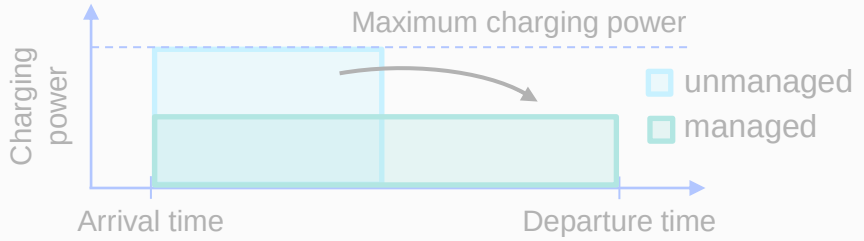
Energy available for charging (during connection time)

Participation rate

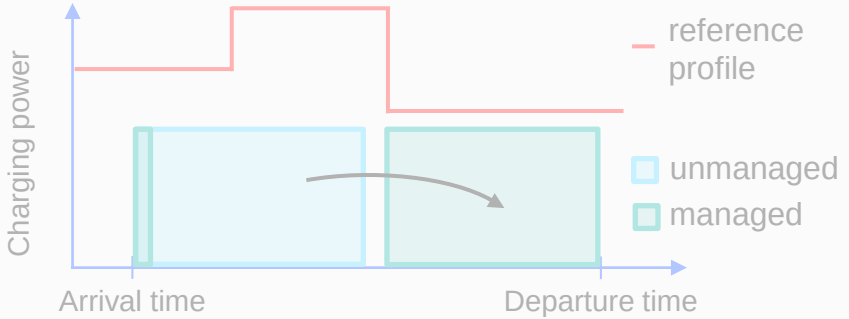
Is the infrastructure adapted? AND
Is the driver willing to participate?

Apply a managed charging measure

Balanced charging

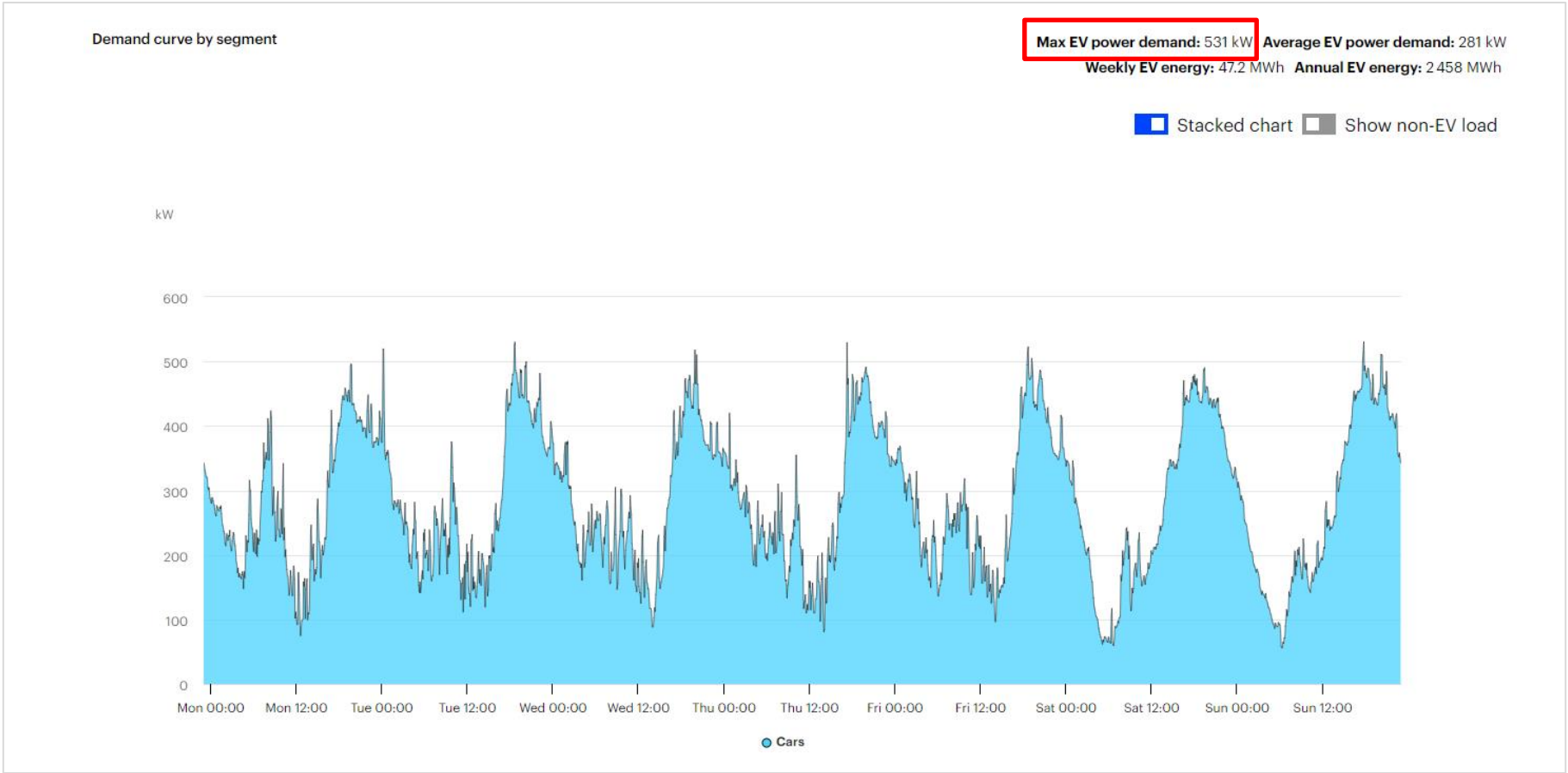


Time-of-Use (ToU) tariffs and smart charging

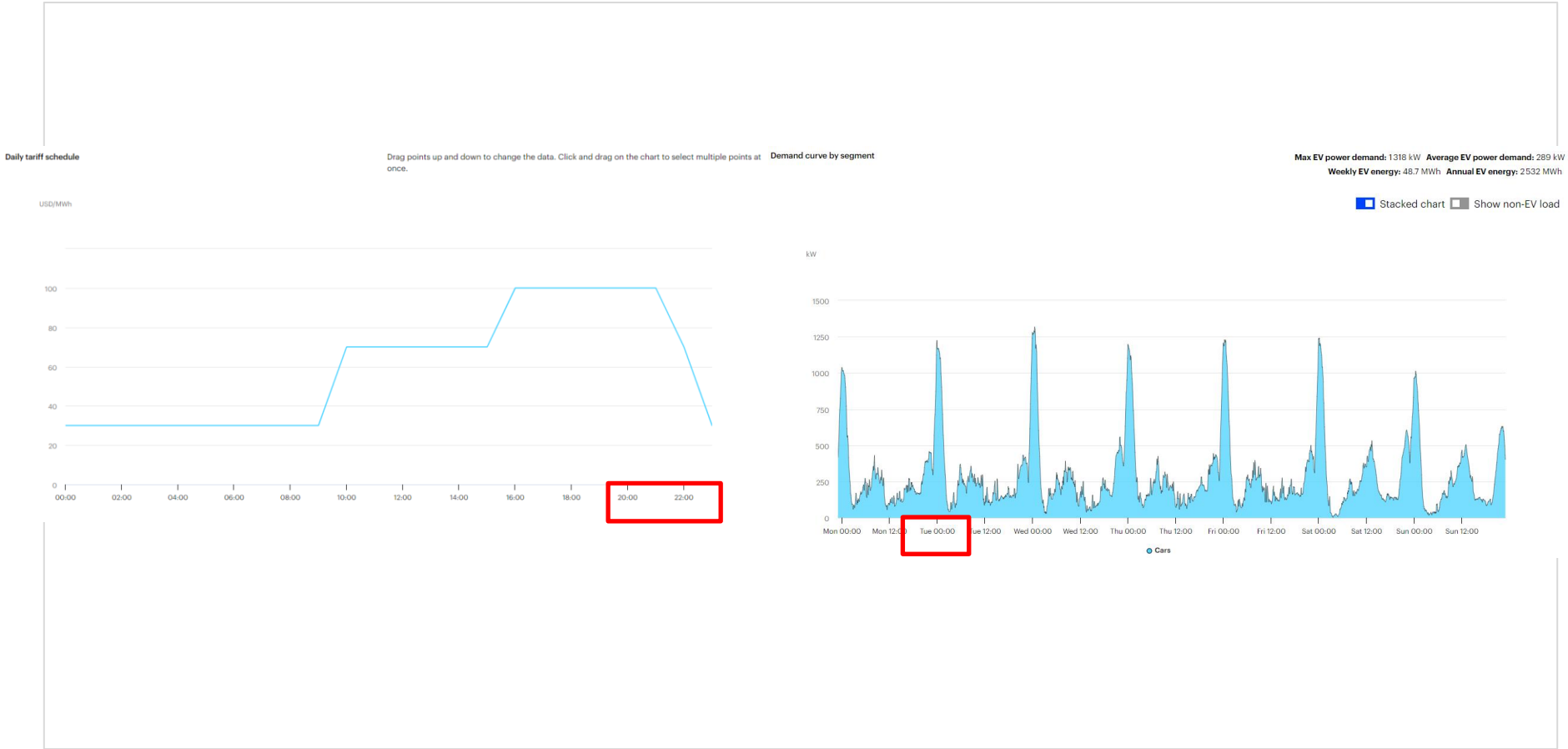


- Shift of energy depending on the **hourly tariff schedule reference electricity demand curve**

Ex: 1000 cars – applying balanced charging



Ex: 1000 cars – applying Time-of-Use tariffs



Ex: 1000 cars – applying V1G

Motivation #3 (Module 3)

Estimating the CO2 emissions related to EV charging

EV charging emissions depend on power mix at time of charging

Estimate of emissions

Net load without and with EV charging

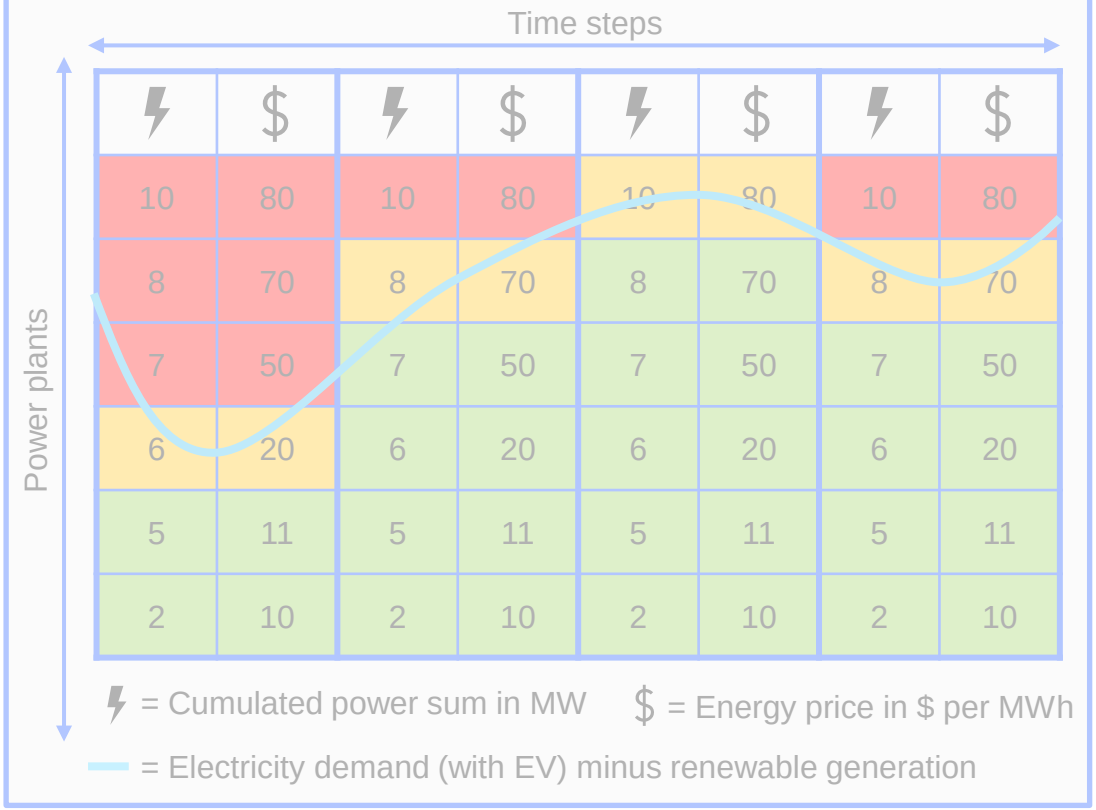
↓

Running power plants

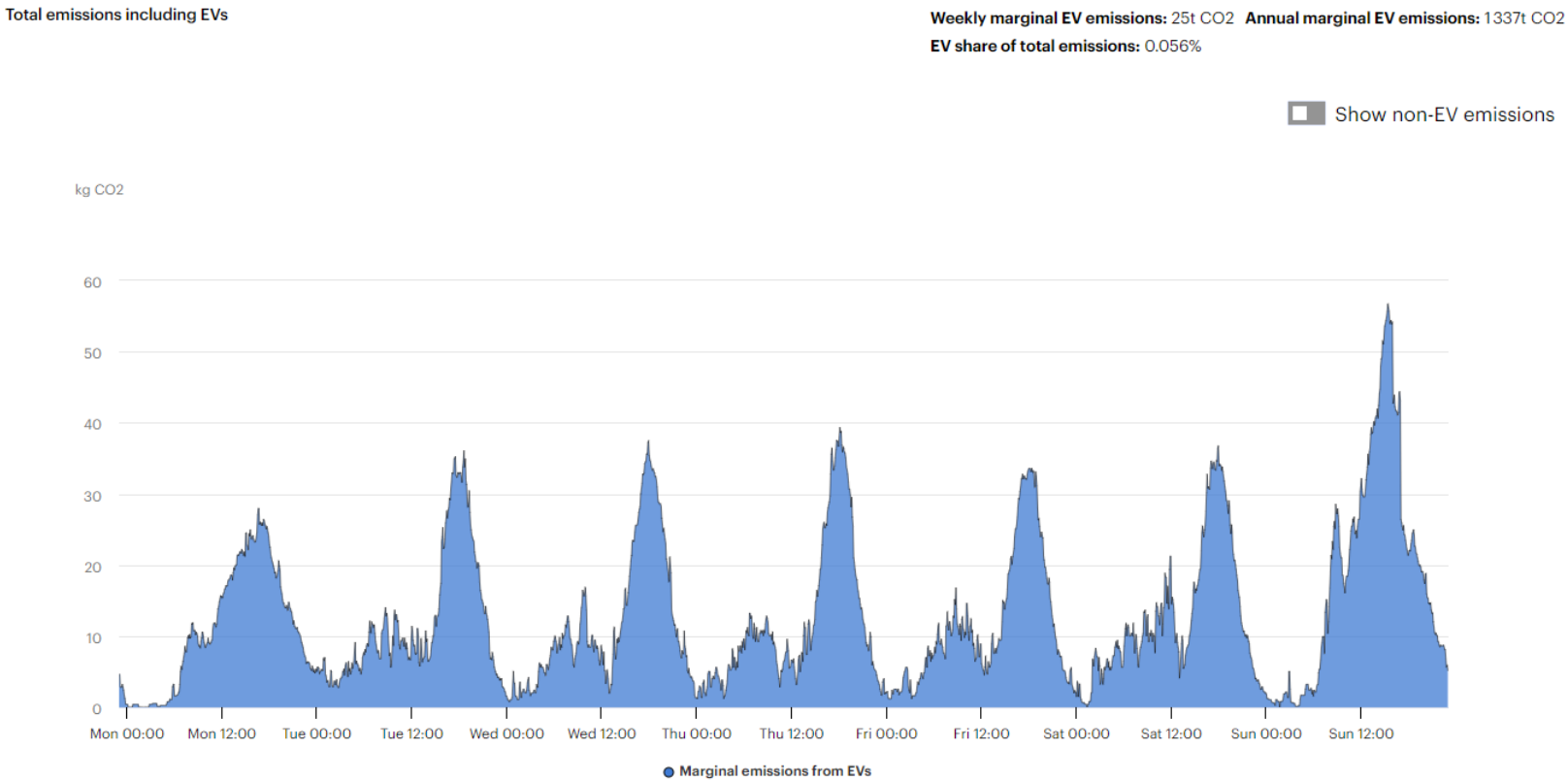
↓

EV charging related emissions by comparison

Simplified dispatch simulation



Ex: 1000 cars – CO2 emissions estimates



Final remarks

- Electrification of road transport is ongoing and will accelerate as it contributes to decarbonisation and helps reducing dependency to fossil fuels
- Electrification will contribute to the increase in electricity demand but is an opportunity for the electricity system as the new electricity end-uses have some embedded flexibility
- The power sector can accommodate a wide range of charging solutions but encouraging managed charging can bring gains in avoided generation costs and emissions, and support faster growth of renewables
- Flexibility of new electricity-end uses needs to be incentivised from early stages
- Our EV Charging and Grid Integration Tool can be a useful resource for a wide range of stakeholders – ranging from pilot project developers, policymakers, and system operators, to utilities and academics

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Q&A

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Thank you for your attention.

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- Tool specifications: **Luis Lopez, Jacques Warichet**
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